Floristics Composition of Tomong Forest at Sambas, West Kalimantan

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Abstract

Tomong forest at Sambas regency is a restricted tropical forest along Sambas riverbank area. The forest have been threatened and decreased due to development of oil palm plantation and human settlement. The plant plant diversity and natural ecosystem in this area should be conserved soon. Sambas botanical garden establishment, which is a serious effort to conserve this forest. Plant Inventory has been conducted on July 15-20, 2008, as the first step to prepare establishing the botanic garden. The floristic composition is a basic important data for botanic garden development planning. The result of inventory shows that there were 153 species of 433 individual trees in the plots sampling with total size of 10 ha (3.3% of total area). These species occurred in three-habitat type on the forest area i.e. riparian, freshwater swamp and heat forest. Dipterocarpaceae is the most important family and as an emergent tree in Tomong forest, there were 17 species in 5 genera belongs to this family, with totally 60 individual trees particularly growing on the sites ≥ 50 m asl. Other important families are Leguminosae, Myrtaceae, Euphorbiaceae, and Sapotaceae.

***Key words**: floristic composition, Tomong forest, botanic garden, Sambas*

Introduction

Sambas is located at 225 km north of Pontianak, the capital city of West Kalimantan. It is situated in the borderline with Malaysia. Historically, the area was belonged to the Sultanate of Sambas, which has close historical relationship with Brunei's Sultanate; it is located along the Sambas and Teberau riverbank (Anonym, 2008). The total area size about 6,395.70 km^2 or 639,570 ha (4.36% of West Kalimantan province), including coastal area with ±128.5 km along the beach and borderline ±97 km.

Like other areas in Kalimantan, Sambas rich of flora-fauna with high endemism, about 34% of Indonesian wild plants are endemic Kalimantan (Ashton, 1982). However, human activities such as development of human settlement and plantation, lead to the decrease of forest area, gradually. Most of the peat swamp forest around sambas regency has been disturbed by land conversion and logging (Siregar and Sambas, 1999). Conversion of natural forest at the borderline into oil palm plantation about 1.8 million ha (Tamburian, 2007) resulted in serious impact to the flora richness of Sambas.

One of remaining forest in West Kalimantan is Tomong riverbank area, where is located at Sabung Stangga village, Subah district, Sambas. This area is an ancestor of Sambas Sultanate which covering 300 ha, but at the moment is being in critical position. The area is threatened by development of settlement and oil palm plantation. So far, the important role of riverbank area as bio-ecohydrology zone supply was ignored. Out of controlled, the riverbank area indeed converting to be human inhabitant (Azis, 2006).

In order to protect the remaining forest at Tomong as germ plasma, developing of Sambas Botanic Garden has been proposed. A better knowledge of basic ecological information, including floristic composition is necessary for development of a sustainable forest management scheme and supports a better forest management for the future (Sutisna, 1985; Kartawinata *et al*., 2008). For this reason, an update and adequate data of floristic are very urgent to make master plan and developing of botanic garden. Exploration on floristic composition of the area is important to understand the floristic composition in relation with species protection and conservation efforts in the future.

Material and Method

The forest inventory was conducted on July 10-20, 2008 with establishing purposive random sampling. Two km long linear transects are established as main axis of transect. These transects were established on various forest type and sampling data were collected along the 2 km transects. Observation and exploration of plants was conducted in 5 m to right and 5 m to left direction along each 5 linear transects. Thus the total sampling areas were 10 ha or 3.3% of the total size Tomong forest.

The schematic of observation area is as below; the grey colour is an observation and exploration area.

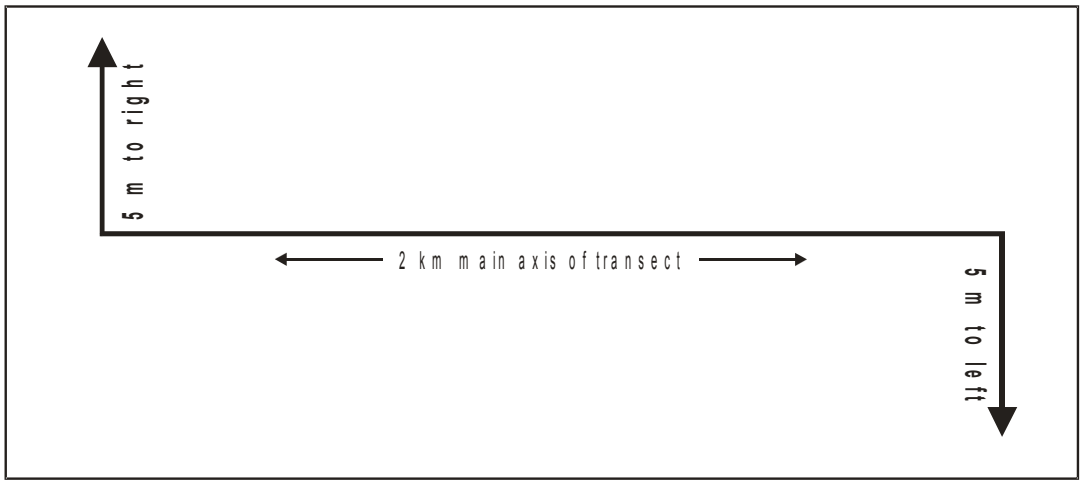

Figure1 Schematic diagram of the observation areas

All trees (DBH ≥ 10 cm) observed along all transects were identified, measured and numbered with a plastic label. The total number of individual of each species is observed qualitatively based on abundance scale defined by Bongers (Kayode, 1999). In addition endemic, endangered and exotic plant were also recorded. Meanwhile, the habitat condition such as topography, altitude, air temperature, soil and air humidity, and soil pH were noted and measured by clinometers, altimeter, thermo hygrometer, and soil tester. These data are used for analyze habitat zonation and floristic composition.

Voucher specimens or fallen leaves or other characteristic parts of plant were collected. These materials were sent to the Herbarium Bogoriense, Cibinong for further identification.

Result and Discussion

Based on topography, altitude and habitat type, there are three main zones recognizable, i.e. riparian zone, freshwater swamp zone, and heat forest zone.

Zone 1 (riparian zone): the topography is relatively flat, altitude up to 20 m asl, the area is very influenced by tidal of the Sambas river and almost along day full of water. The floristic composition is presented in the Table 1.

Table 1. Floristic composition in zone 1 (riparian forest)

Habits	Species	Population
Tree	*Mallotus floribundus* (Blume) Mull.Arg.	Abundant
	Dillenia suffruticosa (Griff.) Martelli	Abundant
	Barringtonia macrocarpa Hask.	Frequent
	Dysoxylum pachyrhache Merr.	Frequent
	Melicope lunu-ankeda (Gaertn.) T.G.Hartley	Occasional
Shrubs	*Psychotria* sp.	Abundant
	Donax cannaeformis (G.Forst.) K.Schum	Abundant
	Leea indica (Burm.f.) Merr	Occasional
	Pandanus helicopus Kurz. Ex Miq.	Frequent
	Belluchia axinanthera Triana	Occasional
Climber	*Uncaria glabrata* DC	Abundant
	Poikilospermum suaveolens (Blume) Merr.	Frequent

Zone 2 (freshwater swamp zone): the topography is ranges from flat to undulate with slope up to 20%, altitude from 20 m to 30 m asl. The area is bordered by riparian zone in far land and heat forest zone in inland; flooded is frequently but sometime is relatively dry. Forest floor is occupied by thiny humus, soil pH 5.0-5.4, soil moisture 70%, humidity 70-75% and air temperature during the day reach up to 30º C. The floristic composition is represented by some species like on the Table 2.

Table 2. Floristic composition in zone 2 (freshwater swamp forest)

Habits	Species	Population
Tree	*Dillenia suffruticosa* (Griff.) Martelli	Frequent
	Mallotus paniculatus (Lam.) Arg.	Frequent
	Belluchia axinanthera Triana	Frequent
	Leea indica (Burm.f.) Merr	Frequent
	Garcinia forbesii King	Occasional
	Melicope lunu-ankeda (Gaertn.) T.G.Hartley	Occasional
Shrubs	*Ixora javanica* (Blume.) D.C.	Occasional
	Macaranga tanarius Mull.Arg.	Frequent
	Tabernaemontana macrocarpa jack	Occasional
Herbs	*Alpinia ligulata* K.schum	Occasional
	Cyperus rotundus L	Occasional
	Curculigo capitulata (Lour.) Kuntze	Frequent
Climber	*Smilax macrophylla* Blume	Frequent
	Nepenthes ampullaria Jack	Frequent
	Medinilla hasseltii Blume	Frequent

Zone 3 (heat forest): the topography relatively undulate to hilly, the altitude higher than 30 m asl. This zone is not influenced by river stream and almost dry daily. In general, the ground is covered by thick humus but in some huge areas are less humus. The daily temperature reach to 35º C, humidity is 70-72%, soil moisture 50-60%, and soil pH 5.5-5.6. Table 3 showed the floristic composition.

Table 3. Floristic composition in zone 3. (heat forest)

Habits	Species	Population
Tree	*Shorea* spp.	Abundant
	Garcinia picrorhiza Miq.	Frequent
	Syzygium spp.	Abundant
	Macaranga javanica Mull.Arg.	Abundant
	Dillenia excelsa Martelli	Occasional
	Calophyllum pulcherrimum Wall	Frequent
	Terminalia copalandii Elmer	Occasional
	Tristaniopsis whiteana (Griff.) Peter. G.Wilson & J.T.Waterh	Frequent
Shrubs	*Syzygium* spp.	Frequent
	Belluchia axinanthera Triana	Frequent
	Diospyros buxifolia (Blume) Hiern	Frequent
	Calamus spectabilis Blume	Frequent
	Quassia indica (Gaertn.) Nooteboom	Occasional
Herbs	*Curculigo capitulata* (Lour.) Kuntze	Frequent
	Maranta arundinacea L.	Frequent
Climber	*Piper crocatum* Ruiz & Pav.	Abundant
	Nepenthes mirabilis Druce	Abundant
	Arcangelisia flava (L.) Merr	Occasional
	Lygodium circinnatum (Burm.f.) Sw.	Frequent
	Millettia splendidissima Blume ex Miq.	Occasional
	Rhaphidophora korthalsii Schott.	Occasional

Results of floristic inventory was also recorded of 153 woody plants species out of 433 individual which consists of trees, shrubs, and climber plants. Their distribution based on the altitude (asl) and diameter class (DBH) is summarized in Table 4.

Table 4. Diameter class distribution according to altitude (asl) and their number and dominant species

Altitude (m asl)	Diameter class (cm)		No of species (individual)	Dominant species
	Range	Abundant		
0-10	14-79	31-35 (4ind)	11 (16)	*Barringtonia macrocarpa* Hask. *Coccoceras borneensis* J.J.Sm,
11-20	13-93	26-30 (12)	46 (89)	*Coccoceras borneensis* J.J.Sm, *Dipterocarpus oblongifolius* Blume, *Cratoxylum cochinchinensis* Blume
21-30	11-92	26-30 (34)	44(84)	*Styphelia malayana* J.J.Sm., *Beilschmiedia maingayi* Hook.f., *Garcinia picrorhiza* Miq., dan *Archidendron jiringa* (Jack.) Nielsen
31-40	12-129	31-35 (14)	35 (53)	*Litsea firma* Hook.f. dan *Tristaniopsis whiteana* (Griff.) Peter. G.Wilson & J.T.Waterh
41-50	21-46	31-35 (13)	26 (42)	*Parastemon urophyllus* A.DC. dan *Syzygium sp.*
51-60	19-160	31-35 (8)	42 (60)	*Shorea* spp.
>60	18-97	26-30 (25)	51 (89)	*Shorea* spp. dan *Vatica rassak* Blume

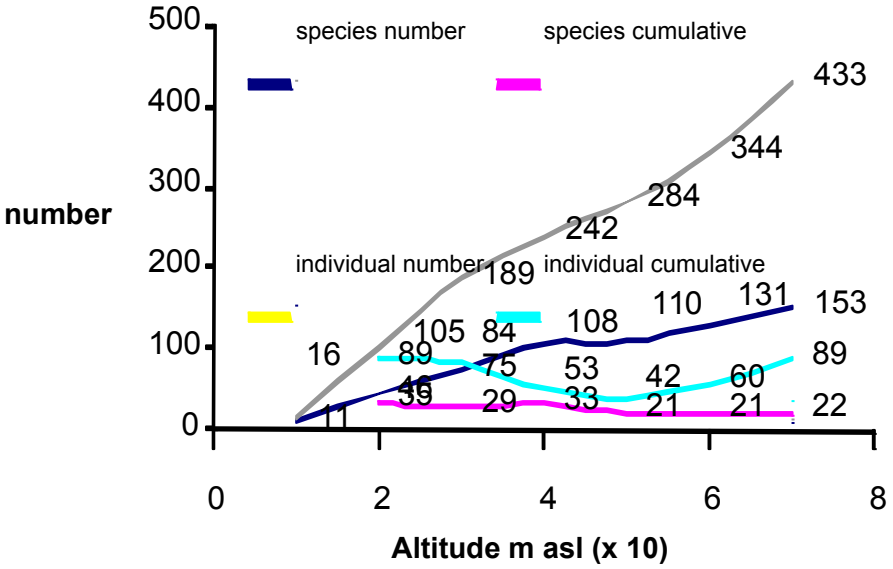

Figure 1. Number of tree species and individual and their cumulative for each 10 m asl

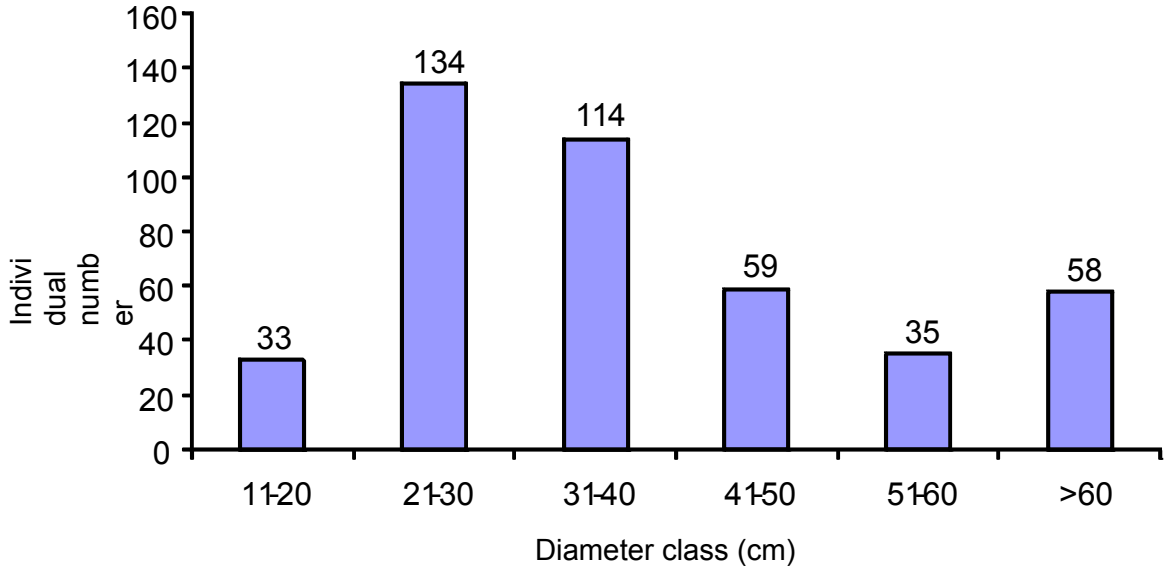

Figure 2. Number of tree individual according to diameter class

Tomong forest is one of area nearby Sambas riverbank zone which is under pressure of huge plantation and inhabitant development. In general this forest has still rich in floristic composition. There were found a number of 153 species out of 433 individual trees in the total plots sampling of 10 ha. This means that it is about 15 species/ha in average or 2.8 Mischung coefficient (individual number divided by species number). This study show a similar result with other inventory results from the other West Kalimantan forest (Partomihardjo, 2005). Forest zonation based on the altitude and effects of water stream is correlated with plant species, which grow up in each zone. Basically soil type in the area is similar, but composition of soil nutrient content of each zones are considerably different. Therefore, the dominant species was different among each other, because of the diversity of habitat type and local endemism are correlated with soil properties. Soil properties have a significant role for richness of plant species (MacKinnon, 1996)

Zone 1 which is categorized as a riparian forest characterized with daily flooded area. Woody trees such as *Dillenia suffruticosa* and *Barringtonia macrocarpa* are growing dominant at the zone In this area could also be found pandan (*Pandanus helicopus*) and

bamban (*Donax cannaeformis*) growing well. In addition, some woody plants in this area had addapted by appearing their root from the ground to be buttressed. This phenomena is common, because plant need the nutrients where there are concentrated on the top 30 cm of soil. Many trees have entirely superficial root systems with no deep penetrating roots at all, as can be seen that tree was fall when the root mass was exposed. Since they lack long taproots, many rain forest trees have evolved great buttress roots to add support for their tall and straight trunks (MacKinnon, 1996). Gawang (*Coccoceras borneensis*), mampat (*Cratoxylum cochinchinensis*), tengkawang batu *(Dipterocarpus oblongifolius*), and selimpau (*Gardenia tubifera* Wall) are some other woody trees that can be found at the zone 1.

The other plants are the woody climber or liana that can grow to be huge in diameter and the stem can reach very long in the zone. These plants generally have roots in the ground forest but their leaves often exposed in full sun, blanketing canopies of trees, often several meters from the ground. *Uncaria glabrata* and akar kuning (*Arcangelisia flava*) are a good sample for the climber here. Some vines like *Piper* spp. (*Piper caninum* and *Piper crocatum*) and *Hoya* sp., were also found climbing on the woody plants. Meanwhile, on the other site of this zone, mainly on the shallow water stream, there were many Araceae such as keladi kuping gajah (*Sagittaria* sp.) and some other aquatic plants such as *Hanguana malayana* (Jack.) Merr.

Zone 2 that is categorized as freshwater swamp forest with shallow peat has more various plant than zone 1. These areas have soil material and plant species more heterogeneous than the deep peat areas (Drasospolino, 2004). There were recorded 108 species up to 40 m asl, it is considerably higher than the other site forest at Sambas generally (Siregar and Sambas 1999). The pioneer species like *Belluchia axinanthera*, *Mallotus floribundus*, *Macaranga tanarius*, and *Leea indica* were found abundant and relatively dominant. Meanwhile, between zone 2 and zone 3, there were various Dipterocarpaceae grow well, mainly genus of Dipterocarpus, Hopea, and Vatica (FAO, . 2008). Asam paya (*Eleiodoxa conferta* Griff.), which produce a candy fruits from Sambas, were also found abundantly in this zone. These plants grow well between palm and rattans. There were also some shrubs like *Tabernaemontana macrocarpa* and *Ixora javanica*, and some species from family Euphorbiaceae, Sterculiaceae, and Myrsinaceae. *Pandanus gladiator* is a good sample of pandan species that grow very adapted between dominant shrubs species *Curculigo capitulata* and *Alpinia ligulata*. In addition, *Belluchia axinanthera* were grown tend toward cluster with groups of bamboo on the relative dry site or neighbour to swamp area. One other exotic plant is *Nepenthes ampullaria* which were also found very abundant nearby the pandanus.

Zone 3 is a dry area that categorized as heat forest. In this zone there were genus of *Tristaniopsis* and *Syzygium* grow uniform separately. Myrtaceae is apparently to be dominant family. Gawang (*Coccoceras borneensis*) and mampat (*Cratoxylum cochinchinensis*), which dominate on zone 1 and some part of zone 2, have been took offer by mentangur (*Calophyllum pulcherrimum*) and mata udang (*Styphelia malayana*) in the zone 3. Seedling/sapling of red melaban (*Tristaniopsis obovata*) and white melaban (*Tristaniopsis whiteana*) are grown very dense on the area of 50-55 m asl mainly with sunlight 10-20%. These all indicate that the area is belong to peat swamp forest or pure kerangas forest (Whitmore *in* MacKinnon, 1996). The character is expressed by densely of sapling and the area is covered by white crystalline sand soil (Beccari, 1986). There were no buttresses or aerial root any more, which are dominant at the zone1. The wasteland (ex gold mine from last project in 2005; Anonim 2008) is located on the 01º 16’ 37.4” N and 109º 28’ 51.0”. E. The soil of these areas is covered by white crystalline sandstone and black water stream that also supporting the condition of heat forest. Flora diversity is various, i.e. *Mussaenda formosa*, *Macaranga triloba*, *Alstonia scholaris*, *Melicope lunu-ankeda*, *Dillenia suffruticosa*, *Mallotus floribundus*, *Carallia brachiata*, *Belluchia axinanthera*, *Tetracera glabra*, and *Uncaria glabra*, also the big tree of *Shorea pinanga* (tengkawang pinang). In the level up 50 m asl, was dominated by family of

Diperocarpaceae particularly genus of Shorea and Vatica, so that the zone 3 might be classified as Dipterocarp lowland heterogeneous forest.

Dipterocarpaceae is an important family and as an emergent tree in Kalimantan rain forest generally. In Tomong forest areas, there were noted that 17 species of 5 genera belongs to Dipterocarpaceae family, with total of 60 tree individuals. That means it was 11% of the total species and 14% of the total individual tree on the sampling sites. This situation is similar with Sudarmono and Widyatmoko (1998) inventory reported at other sites of Sambas forest, Gunung Niut Nature Reserve. This is supported by Purwaningsih reviews (2004) that based on the observation of herbarium collection in Herbarium Bogoriense the distribution of most dipterocarps species was in the altitude of 0-500 m particularly for *Shorea spp*. *Shorea* spp. are commonly as a big tree with stem diameter reach 30 cm up in average and trunk high of 20 m up, followed by Leguminosae family such as *Dialium* and *Koompassia*. The most frequent diameter is 21 to 30 cm that is consist of 134 individual trees mainly belong to Leguminosae and Sapotaceae. As a sub emergent were some species of Myrtaceae, Euphorbiaceae, and Sapotaceae. According to individual number, Myrtaceae (50 individual recorded) was competitive with Dipterocarpaceae, however the Myrtaceae have individual tree with average diameter ≤ 50 cm. Myrtaceae family representatively only 3 genera and 4 species, the most important tree is melaban (*Tristaniopsis obovata* and *Tristaniopsis whiteana*), that is big diameter and straight trunks. Euphorbiaceae is a family with the highest number of species representatively (10 species) but only have 34 individual trees, so still under the Myrtaceae. The other families with high number of species representatively are Clusiaceae and Lauraceae, each of 8 species. Meliaceae is a lowest family for species representative; there was only *Lansium domesticum,* a kind local fruit that grew in local society's garden in Kalimantan (Siregar, 2006). Meanwhile the Hypericaceae family is only represented by genus of Cratoxylum.

Dipterocarpaceae were also dominant family on the land ≥ 50 m asl., which characteristic dry ground forest but have thick humus. Out of these, *Shorea foraminifera* and *Dipterocarpus oblongifolius* were found frequently on sites ≤ 20 m asl., particularly nearby river stream. *D. oblongifolius,* like reported by Partomihardjo (2005), is found preference on the riverbank of Muller Mountains. Meanwhile, species of Myrtaceae commonly dominate on the sites of 30-50 m asl. The other family more concentrated on the sites ≤ 40 m asl. Figure 1 showed that number of species was increasing from 10 m asl up to 40 m asl, and after that deacreasing gradually. The increasing number of species on 50 m asl especially dominated by Dipterocarpaceae and *Ficus spp*.

Some of plants on Tomong forest are categorized as endemic and endangered species of Borneo. Bulian (*Eusideroxylon zwageri* Teijsm. & Binn.) is one of Kalimantan endemic species which as a target of illegal logging. There were some endangered species of Dipterocarpaceae such as *Shorea ovata* Dyer and *Anisoptera marginata* Korth; this is because people used them as main wood for construction. There were also some exotic plants, belongs to Zingiberaceae (*Alpinia ligulata*) and Nepenthaceae (*Nepenthes spp*.) which abundantly covering forest ground. *Nepenthes ampullaria* (entuyut) particularly grow well at zone 2, on more humus and wet, but not for other sites. While *N. mirabilis* and *N. gracilis* preference dominate on zone 3 and 2 where the habitat is belong to type of swamp and heat forest (Clarke, 1997).

Conclusion

Tomong forest could be divided into three-habitat type i.e. riparian forest, freshwater swamp forest, and heat forest. On these sites, there were many unique, endangered and specific plants with high-threatened species. Dipterocarpaceae is a dominant family and most of them are emergent particularly on the heat forest zone, meanwhile Myrtaceae family was represented by Tristaniopsis; which is the specific genus to this site. The most trees with DBH class of 21-30 cm which consists of 134 individual mainly belong to Fabaceae and Sapotaceae. Beside of potential woody plants, there were also some exotic plants like kantung semar (*Nepenthes* spp.) that grow abundantly on the sites.

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